PROJECT NUMBER: 1702
PROJECT TITLE: Aerosol Generation and Filtration
PROJECT LEADER: K. Cox
PERIOD COVERED: October, 1987

I. SUBJECT: OPTICAL INSPECTION SYSTEMS

A. Objective: Develop optical processing techniques for the inspection of cigarette packs.

B. Results: The acquisition of a video library containing images of both good and defective (fabricated) packs has been completed.

Software routines were written to align (scale, rotate, and translate) images and to form the dot product matrix, **A**, for any given image set. The elements of this matrix are $A_{ij} = F_i.F_j$ where F_i is a vector of length 512^2 and contains the image intensities. The calculation of the dot product matrix has been carried out for a set of images of both good packs and those with bad tear tape. A synthetic discriminant function (SDF) for discriminating between the good and bad images will be calculated from this matrix using a theory developed earlier. This function will be used to design a matched spatial filter for use in an optical detection system capable of distinguishing between the two pack types.

Two LCD-T's (made by Epison and Casio) have been modified. The illumination sources, scattering screens, and polarizers were removed and the screens made more homogeneous and optically flat by cementing optical flats cut from holographic film plates onto both sides. An optical processing system was assembled to test the performance of the modified LCD-TV's. When the Epison unit was used to encode images of different cigarette packs on a laser beam, the images produced were found to be of a much higher quality than those produced previously using other LCD-TV's.

One of the most promising optical detection systems currently being considered is based on an optical Hough transformation. The results obtained using this system can be improved significantly if the image is edge enhanced prior to the Hough transformation. We have found that edge enhancement can be very effectively carried out simply by rotating the polarizers used with the LCD-TV's by 45 degrees.

D. Plans:

1. Complete evaluation of the LCD-TV's for use in an optical processing system.

2. Evaluate the Global Holonetics SMART CAMERA. Determine its effectiveness in discriminating between good and defective cigarette packs.

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3. Calculate the synthetic discriminant function (SDF) for the bad tear tape image set. Determine the effectiveness of the SDF for discriminating between the images of good and defective packs.